



## STGP3NB60H

### N-CHANNEL 3A - 600V TO-220 PowerMESH™ IGBT

TYPE	V <sub>CES</sub>	V <sub>CE(sat)</sub>	I <sub>C</sub>
STGP3NB60H	600 V	< 2.8 V	3 A

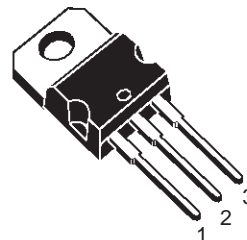
- HIGH INPUT IMPEDANCE (VOLTAGE DRIVEN)
- LOW ON-VOLTAGE DROP (V<sub>cesat</sub>)
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- VERY HIGH FREQUENCY OPERATION
- OFF LOSSES INCLUDE TAIL CURRENT

#### DESCRIPTION

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "H" identifies a family optimized to achieve very low switching times for high frequency applications (<120kHz).

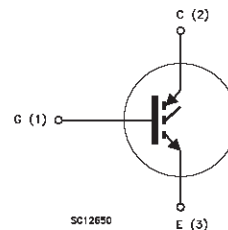
#### APPLICATIONS

- HIGH FREQUENCY MOTOR CONTROLS
- SMPS AND PFC IN BOTH HARD SWITCH AND RESONANT TOPOLOGIES



TO-220

#### INTERNAL SCHEMATIC DIAGRAM



#### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V <sub>CES</sub>	Collector-Emitter Voltage (V <sub>GS</sub> = 0)	600	V
V <sub>ECR</sub>	Emitter-Collector Voltage	20	V
V <sub>GE</sub>	Gate-Emitter Voltage	± 20	V
I <sub>C</sub>	Collector Current (continuous) at T <sub>c</sub> = 25 °C	6	A
I <sub>C</sub>	Collector Current (continuous) at T <sub>c</sub> = 100 °C	3	A
I <sub>CM</sub> (•)	Collector Current (pulsed)	24	A
P <sub>tot</sub>	Total Dissipation at T <sub>c</sub> = 25 °C	70	W
	Derating Factor	0.56	W/°C
T <sub>stg</sub>	Storage Temperature	-65 to 150	°C
T <sub>j</sub>	Max. Operating Junction Temperature	150	°C

(•) Pulse width limited by max. junction temperature

## STGP3NB60H

### THERMAL DATA

R <sub>thj-case</sub>	Thermal Resistance Junction-case	Max	1.78	°C/W
R <sub>thj-amb</sub>	Thermal Resistance Junction-ambient	Max	62.5	°C/W
R <sub>thc-sink</sub>	Thermal Resistance Case-sink	Typ	0.5	°C/W

### ELECTRICAL CHARACTERISTICS (T<sub>j</sub> = 25 °C unless otherwise specified)

#### OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>BR(CES)</sub>	Collector-Emitter Breakdown Voltage	I <sub>C</sub> = 250 μA V <sub>GE</sub> = 0	600			V
I <sub>CES</sub>	Collector cut-off (V <sub>GE</sub> = 0)	V <sub>CE</sub> = Max Rating T <sub>j</sub> = 25 °C V <sub>CE</sub> = Max Rating T <sub>j</sub> = 125 °C			10 100	μA μA
I <sub>GES</sub>	Gate-Emitter Leakage Current (V <sub>CE</sub> = 0)	V <sub>GE</sub> = ± 20 V V <sub>CE</sub> = 0			± 100	nA

#### ON (\*)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>GE(th)</sub>	Gate Threshold Voltage	V <sub>CE</sub> = V <sub>GE</sub> I <sub>C</sub> = 250 μA	3		5	V
V <sub>CE(SAT)</sub>	Collector-Emitter Saturation Voltage	V <sub>GE</sub> = 15 V I <sub>C</sub> = 3 A V <sub>GE</sub> = 15 V I <sub>C</sub> = 3 A T <sub>j</sub> = 125 °C		2.4 1.9	2.8	V V

#### DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g <sub>fs</sub>	Forward Transconductance	V <sub>CE</sub> = 25 V I <sub>C</sub> = 3 A	1.3	2.4		S
C <sub>ies</sub> C <sub>oes</sub> C <sub>res</sub>	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V <sub>CE</sub> = 25 V f = 1 MHz V <sub>GE</sub> = 0	160 23 4.5	235 33 6.6	300 43 8.6	pF pF pF
Q <sub>G</sub> Q <sub>GE</sub> Q <sub>GC</sub>	Total Gate Charge Gate-Emitter Charge Gate-Collector Charge	V <sub>CE</sub> = 480 V I <sub>C</sub> = 3 A V <sub>GE</sub> = 15 V		21 6 7.6	27	nC nC nC
I <sub>CL</sub>	Latching Current	V <sub>clamp</sub> = 480 V R <sub>G</sub> = 10 Ω T <sub>j</sub> = 150 °C	12			A

#### SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t <sub>d(on)</sub> t <sub>r</sub>	Delay Time Rise Time	V <sub>CC</sub> = 480 V I <sub>C</sub> = 3 A V <sub>GE</sub> = 15 V R <sub>G</sub> = 10 Ω		16 30		ns ns
(di/dt) <sub>on</sub>	Turn-on Current Slope	V <sub>CC</sub> = 480 V I <sub>C</sub> = 3 A R <sub>G</sub> = 10 Ω V <sub>GE</sub> = 15 V		400		A/μs
E <sub>on(○)</sub>	Turn-on Switching Losses	T <sub>j</sub> = 125 °C		37		μJ

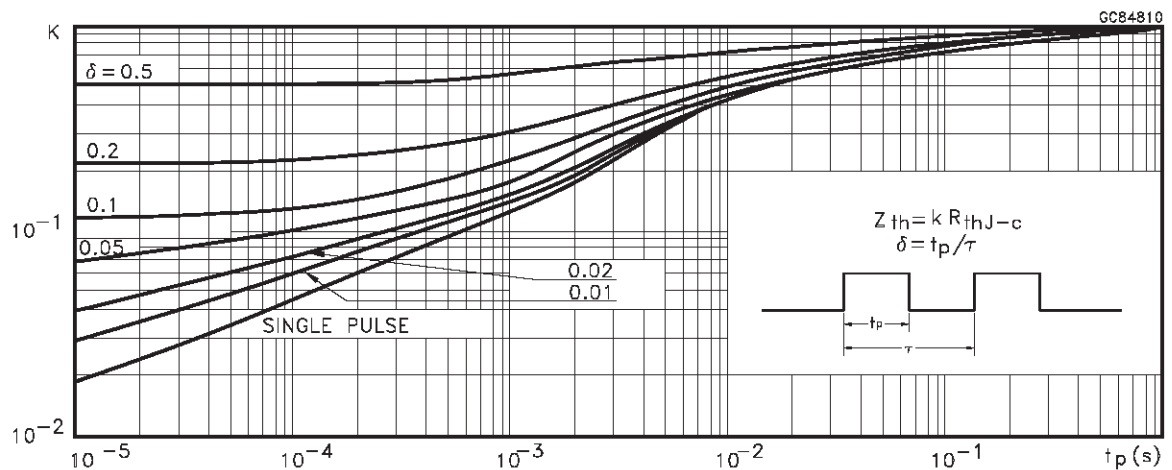
**ELECTRICAL CHARACTERISTICS** (continued)**SWITCHING OFF**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_c$	Cross-Over Time	$V_{CC} = 480 \text{ V}$ $I_C = 3 \text{ A}$		90		ns
$t_r(V_{off})$	Off Voltage Rise Time	$R_{GE} = 10 \text{ } \Omega$ $V_{GE} = 15 \text{ V}$		36		ns
$t_d(off)$	Delay Time			53		ns
$t_f$	Fall Time			70		ns
$E_{off}(**)$	Turn-off Switching Loss			33		$\mu\text{J}$
$E_{ts}$	Total Switching Loss			65		$\mu\text{J}$
$t_c$	Cross-Over Time	$V_{CC} = 480 \text{ V}$ $I_C = 3 \text{ A}$		180		ns
$t_r(V_{off})$	Off Voltage Rise Time	$R_{GE} = 10 \text{ } \Omega$ $V_{GE} = 15 \text{ V}$		82		ns
$t_d(off)$	Delay Time	$T_j = 125 \text{ } ^\circ\text{C}$		58		ns
$t_f$	Fall Time			110		ns
$E_{off}(**)$	Turn-off Switching Loss			88		$\mu\text{J}$
$E_{ts}$	Total Switching Loss			125		$\mu\text{J}$

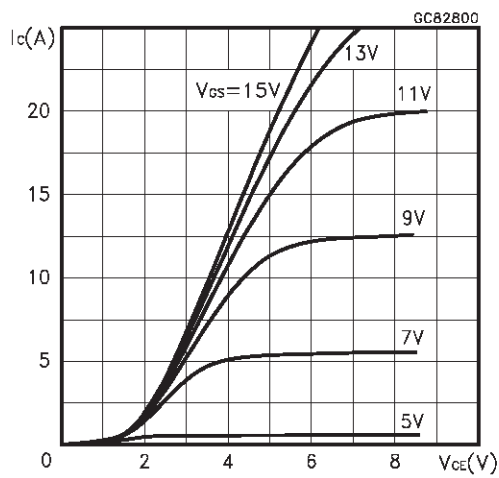
(●) Pulse width limited by max. junction temperature

(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %

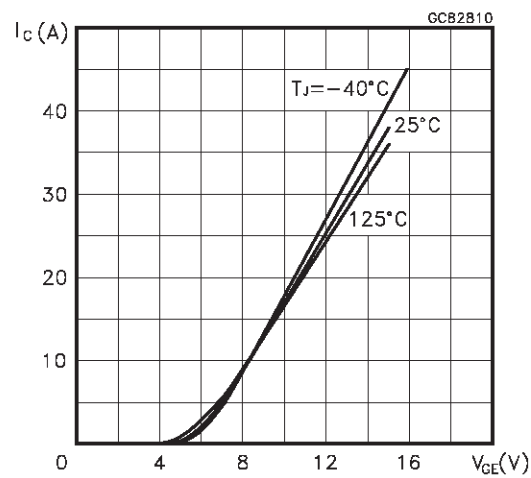
(\*\*) Losses Include Also The Tail (Jedec Standardization)

**Thermal Impedance**

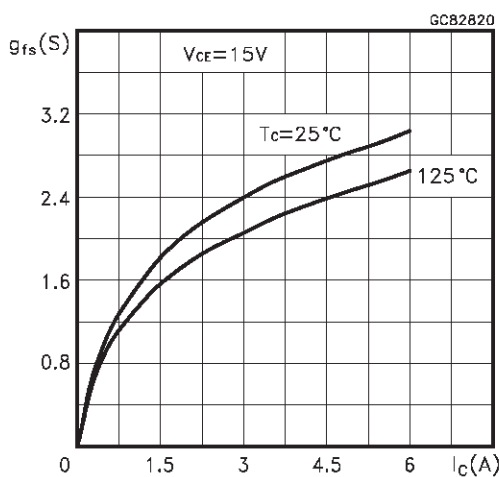
Output Characteristics



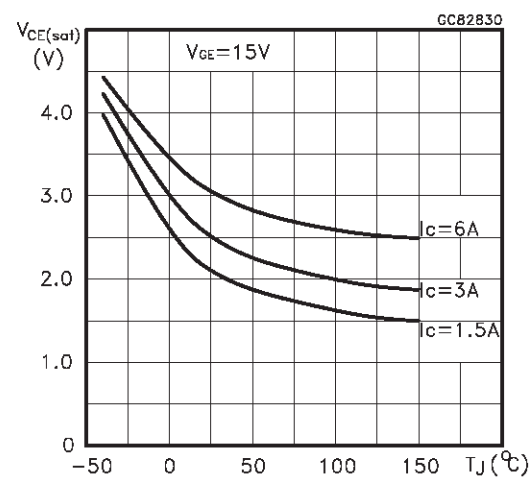
Transfer Characteristics



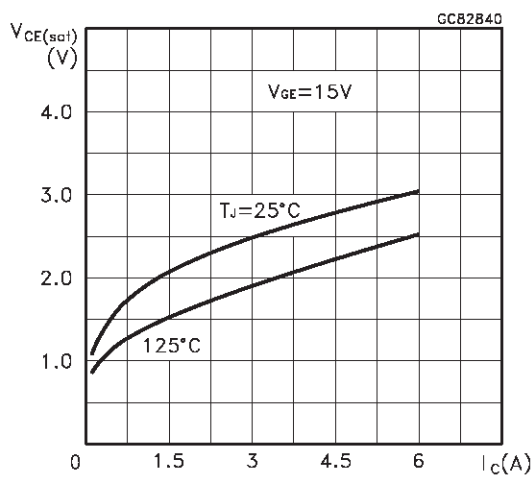
Transconductance



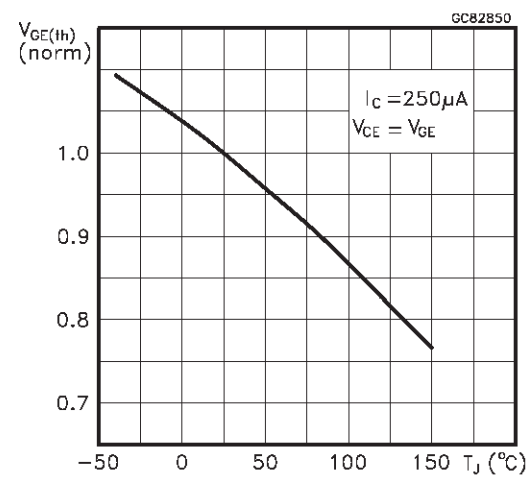
Collector-Emitter On Voltage vs Temperature



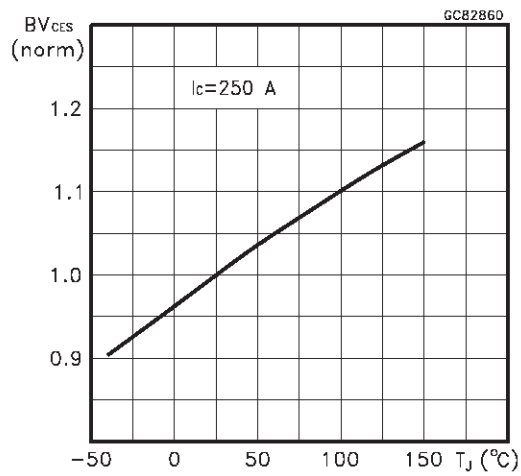
Collector-Emitter On Voltage vs Collector Current



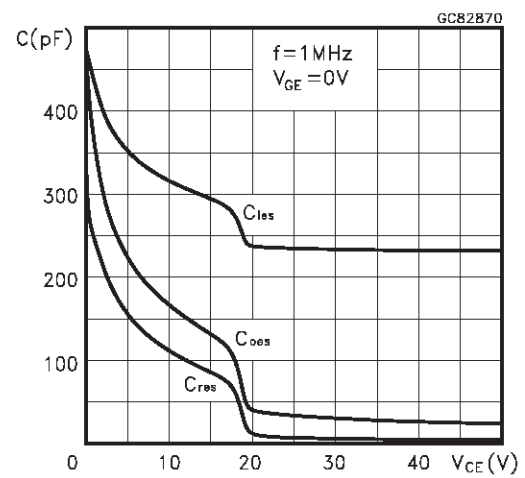
Gate Threshold vs Temperature



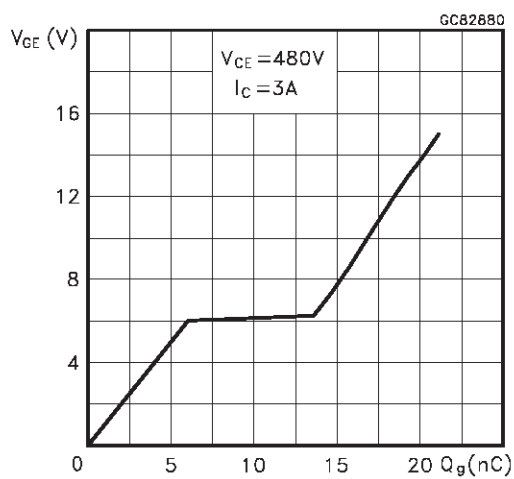
Normalized Breakdown Voltage vs Temperature



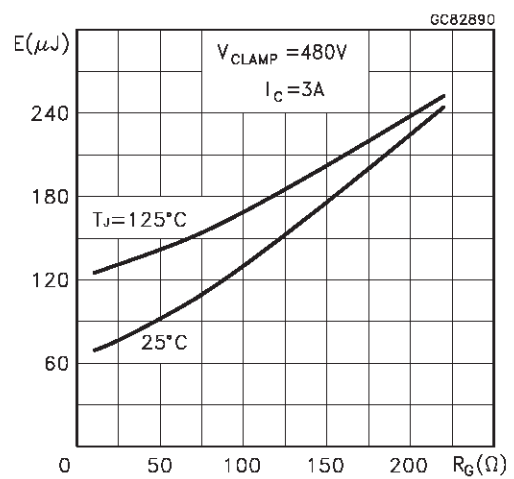
Capacitance Variations



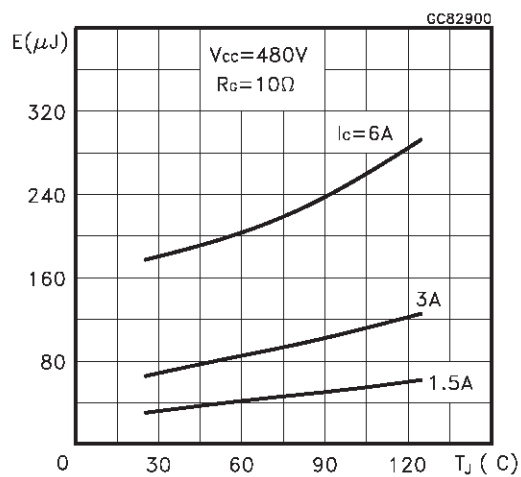
Gate Charge vs Gate-Emitter Voltage



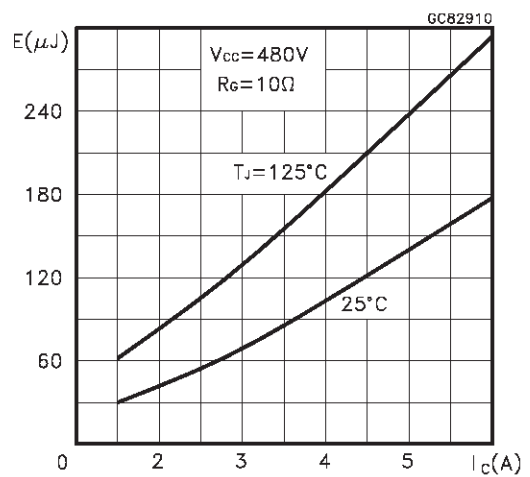
Total Switching Losses vs Gate Resistance



Total Switching Losses vs Temperature



Total Switching Losses vs Collector Current



Switching Off Safe Operating Area

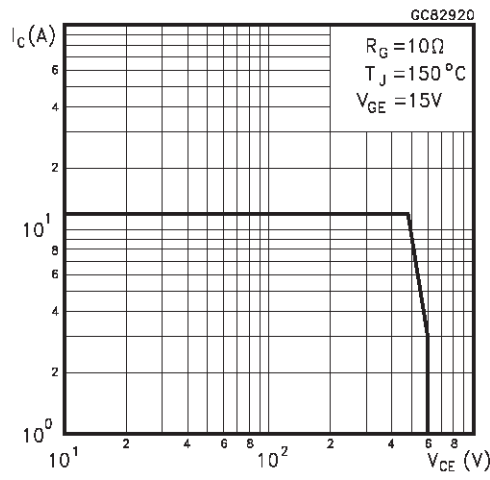


Fig. 1: Gate Charge test Circuit

Fig. 2: Test Circuit For Inductive Load Switching

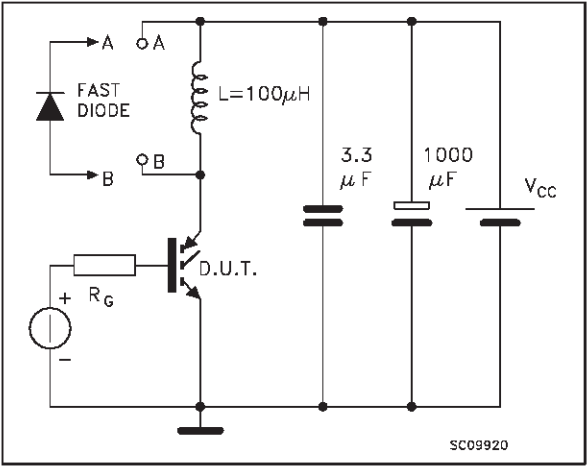
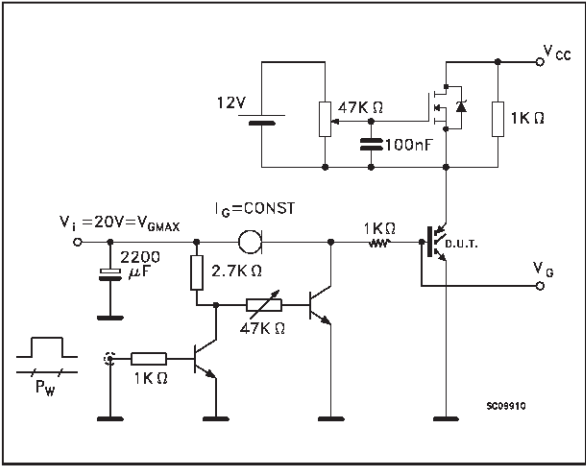
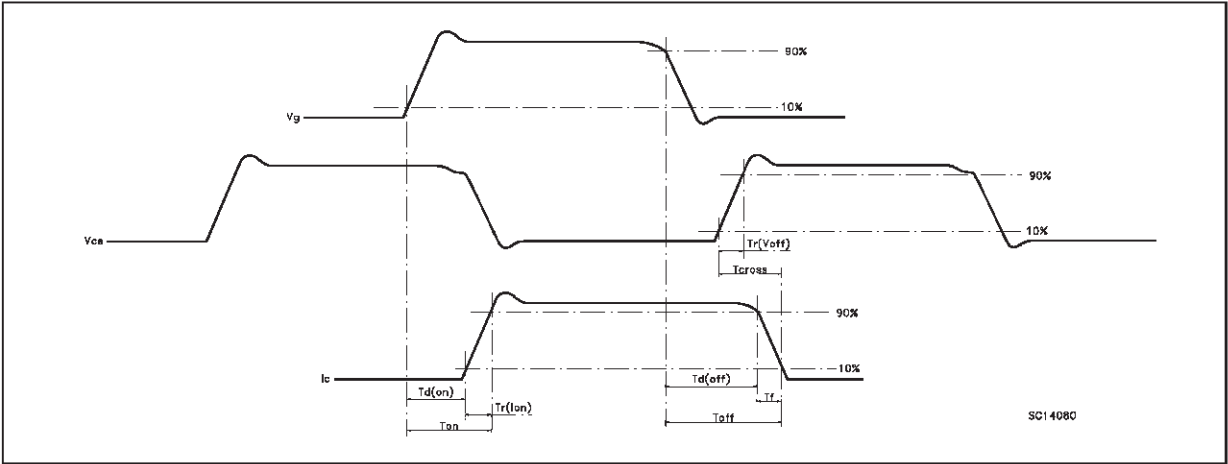
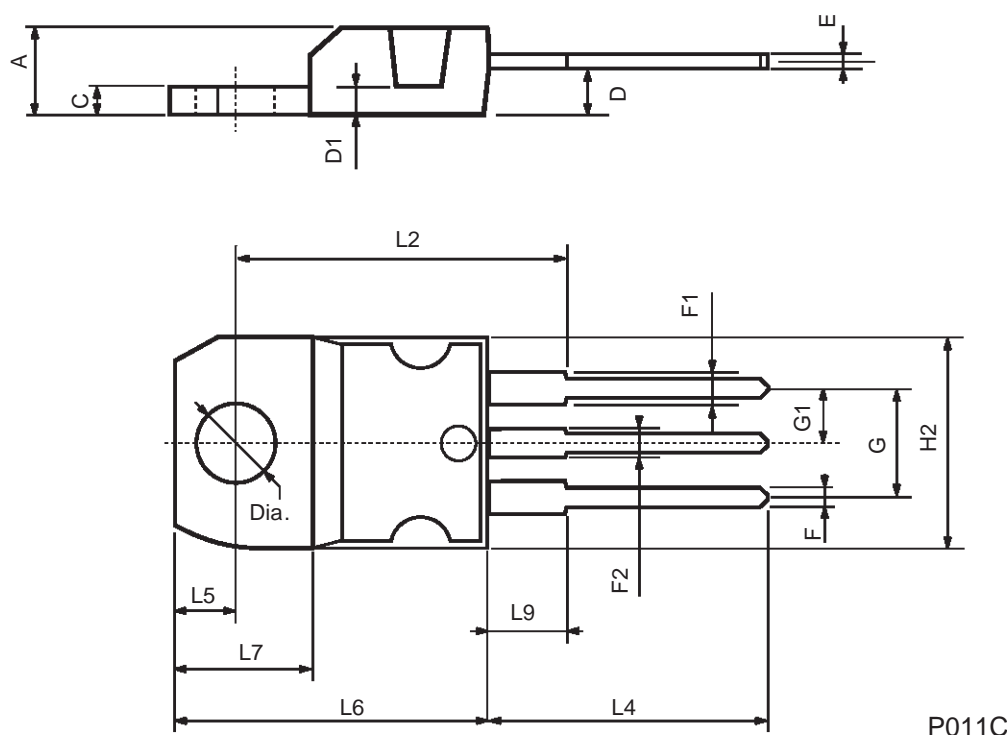


Fig. 3 Switching Waveforms



## TO-220 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
D1		1.27			0.050	
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
H2	10.0		10.40	0.393		0.409
L2		16.4			0.645	
L4	13.0		14.0	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.2		6.6	0.244		0.260
L9	3.5		3.93	0.137		0.154
DIA.	3.75		3.85	0.147		0.151



Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specification mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

The ST logo is a trademark of STMicroelectronics

© 1999 STMicroelectronics – Printed in Italy – All Rights Reserved  
STMicroelectronics GROUP OF COMPANIES

Australia - Brazil - China - Finland - France - Germany - Hong Kong - India - Italy - Japan - Malaysia - Malta - Morocco -  
Singapore - Spain - Sweden - Switzerland - United Kingdom - U.S.A.

<http://www.st.com>